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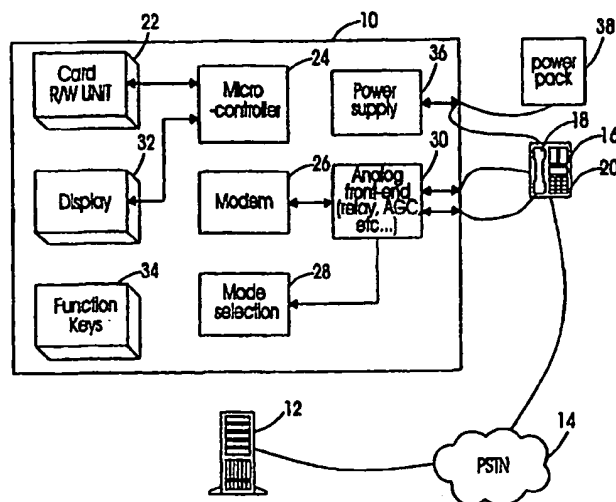
(57) Abstract

A smart card reader (10) and transaction system which uses the voice path of a switched telephone network (14) to effect smart card transactions. The smart card reader may be used with either a regular telephone (16) or an ADSI telephone. If the telephone is not a handsfree set, the smart card reader is preferably connected between the base set (20) and the handset (18). If the telephone is a handsfree model, the card reader is positioned between the base set and the switched telephone network. A smart card application server (12) controls the smart card reader and switches it between a user mode and a card communications mode. Most applications software resides on the application server so that the smart card reader is simple to construct and inexpensive to manufacture. The advantage is a simple, portable, inexpensive yet reliable system adapted to be owned and used by the general public.

PORTABLE SMART CARD READER AND TRANSACTION SYSTEM

TECHNICAL FIELD

The present invention relates to smart card
5   transaction systems and, in particular, to a smart card
reader and transaction system that uses a voice path
through a switched telephone network to effect smart card
transactions.

10   BACKGROUND OF THE INVENTION

Remote   transactions   effected   by   telephone
connections have been developed to a significant extent
over the past few years. They are effected using a
telephone   network   connection   between   a   transaction
15   terminal and an application server. The application
server may send voice prompts to the user, who responds
using the keys of the terminal keypad. The signals
returned to the application server are generally of the
dual   tone   multi-frequency   (DTMF)   type.   These
20   transactions generally occur at a location remote from a
bank or a credit bureau. A disadvantage of such systems
is that it is relatively easy for a person to use a
misappropriated card or for a legitimate card owner to
exceed their credit limit. Most merchants, therefore,
25   require that before purchases above a relatively modest
amount are completed, an authorization must be verified
with the bank or credit bureau, as appropriate. Even
with automated dialling, the procedure is also cumbersome
and time consuming. Furthermore, a separate card is
30   required for each account.

In this particular use of a telephone network,
there is a vital need for security when the transactions

of a monetary type, such as electronic funds transfer are effected and, in more general terms, whenever there is a risk of fraud.

In order to provide a requisite level of security, telephone terminals have been invented with data processing capability and an RS 232 serial data interface connected to a smart card reader. Such telephone terminals incorporate software programs appropriate for data communications with an application server. The card reader is used with a smart card enabled with security functions, such as user passwords, the authentication of host applications, assistance in the authentication of the card by a host application and the recordal of transactions, etc.

Such smart cards and smart card readers are well known in the art. Smart card readers read and write to smart cards using various contacts for data transfer. As an example, United States Patent No. 4,798,322 which issued on January 17, 1989 to Bernstein et al. is entitled CARD READER/WRITER STATION FOR USE WITH A PERSONAL MEMORY CARD USING DIFFERENTIAL DATA TRANSFER. This patent describes a card reader arranged for use with a contactless smart card. The card reader is adapted to interface with an application station such as a factory editing station, an office editing station, issue editing station, public telephone station or any other station suitably configured for interfacing with a smart card.

Although such devices are satisfactory for certain applications, they suffer from the disadvantage of requiring telephone terminals equipped with a data processing peripheral connector. Ordinary telephone terminals are not generally equipped with such a

connector so that the devices are not adapted to be owned
and operated by the general public.

Efforts have been developed to overcome this
disadvantage by offering a simple way to perform
5   transactions using standard telephone terminals. United
States Patent No. 5,740,232, for example, which issued on
April 14, 1998 to Pailles et al. and is entitled SMART
CARD BASED SYSTEM FOR TELEPHONE-SECURIZED TRANSACTIONS,
discloses a smart card reader which incorporates a smart
10   card reader, a sound transmission device, a display
surface and a keypad as well as a plurality of function
keys. The smart card reader uses a PSTN voice path to
communicate with an application server but does so in one
direction by sound signals which are generated by the
15   smart card reader and received by the telephone. In the
other direction, the application server communicates
through the telephone handset with the user who
transcribes the information into the smart card reader
using the keypad. The disadvantages of this system are
20   apparent in that interference from environmental noise
can obviously effect transactions and errors or fraud may
occur because of the manual operation involved in one-way
information transmission. Those disadvantages may have
an undesirable impact on the reliability of the device.
25   Therefore, there exists a need for a smart card reader
which may be connected to an ordinary telephone terminal
and a system which enables the smart card reader to work
securely and reliably.

30   **OBJECTS OF THE INVENTION**

An object of the invention is to provide a
smart card transaction system which uses a voice path

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through a switched telephone network to communicate with a smart card application server.

A further object of the invention is to provide a method of using a voice path through a switched
5   telephone network to effect smart card transactions.

Another object of the invention is to provide a smart card reader which may be connected to an ordinary telephone terminal to communicate with an application server for a smart card transaction.

10   Yet another object of the invention is to provide a smart card transaction system that enables a portable smart card reader to operate in conjunction with a telephone terminal for smart card transactions.

Another object of the invention is to provide a
15   portable smart card reader which may be connected to a telephone terminal to permit a keypad of the telephone terminal to be used to input information during communication with an application server for smart card transactions.

20

SUMMARY OF THE INVENTION

In accordance with one aspect of the invention, there is provided A portable smart card reader (10) adapted for communication with an application server (12)
25   using a voice path of a switched telephone network (14), the smart card reader including a smart card reader/writer unit (22) for reading information from and writing information to a smart card (52) inserted in a slot (50) for receiving the smart card, a micro-
30   controller (24) for operational control of the smart card reader/writer unit and a display unit (32), C H A R A C T E R I Z E D by:

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a front-end (30) for selectively connecting the
smart card reader/writer unit (22) to a telephone line
that is shared with a telephone terminal (16) to permit
communication with the application server, and to

5   selectively disconnect the smart card reader/writer unit
(22) from the telephone line to permit a keypad of the
telephone terminal to function as a user interface for
input of information during a smart card transaction
session.

10   Preferably, the micro-controller controls a
mode selection between a card communication mode and a
user input mode during a card transaction session, and
mutes the handset in the card communication mode.

The smart card reader preferably comprises a
15   connection detector associated with the micro-controller
and the front-end for detecting a connection signal sent
from the application server to activate the card
communication mode. The user input mode is preferably a
default mode.

20   In accordance with a second aspect of the
invention, there is provided a smart card transaction
system that uses a voice path through a switched
telephone network (14) to perform smart card
transactions, the transaction system including an
25   application server (12) connected to the switched
telephone network; a telephone terminal (16) connected to
the switched telephone network, the telephone terminal
having a keypad; and, a portable smart card reader (10)
for communication with the application server (12), the
30   smart card reader including: a smart card reader/writer
unit (22) for reading information from and writing
information to a smart card (52); a micro-controller (24)

associated with the smart card reader/writer unit for controlling same; a display unit (32) associated with the micro-controller for displaying information; and, a slot (50) for receiving a smart card (52),

5   C H A R A C T E R I Z E D by:

the smart card reader further including a front-end (30) linked to the smart card reader/writer unit (22) for selectively connecting the smart card reader/writer unit to a telephone line that is shared by

10   a telephone terminal (16), to enable communication with the application server (12) and selectively disconnecting the smart card reader/writer unit (22) from the telephone line to permit a keypad of the telephone terminal to be used as a user interface for input of information during

15   a smart card transaction session.

The micro-controller preferably controls a mode selection between a card communication mode and a user input mode during the card transaction session and mutes the handset or the telephone in the card communication

20   mode.

The application server preferably includes a first interface associated with application software to communicate with and control the telephone; and, a second interface associated with the application software to

25   communicate with and control the smart card reader. The second interface preferably generates a connection signal to prompt the smart card reader to switch to the card communication mode.

In accordance with a third aspect of the

30   invention, there is provided a method of using a voice path trough a switched telephone network (14) for a smart card transaction comprising the steps of: receiving a

call from a telephone terminal (16) connected to a telephone line of the switched telephone network (14) at an application server (12) which is connected to the switched telephone network; verifying from the

5   application server (12) that a smart card reader (10) is communicating over the telephone line of the switched telephone network and a smart card is properly associated therewith; verifying at the application server the smart card user ID information by retrieving smart card user ID

10   information from the smart card in a card communication mode and comparing the retrieved information with input user ID information; and exchanging transaction data between the smart card and the application server in the card communication mode, C H A R A C T E R I Z E D by

15   the steps of:

a)   inputing the smart card user ID information using a keypad of the telephone terminal (16) in a user input mode;

b)   inputing application server transaction
20   information using the keypad of the telephone terminal in the user input mode; and

c)   prompting the smart card reader (10) from the application server to induce the smart
25   card reader to switch selectively between the user input mode that permits the input through the keypad of the telephone terminal (16) and the card communication mode that permits information exchange between the
30   smart card and the application server.

The application server preferably sends a connection signal to activate switching from the user input mode to the card communication mode.

The advantages of the invention are apparent.

5   First, it provides a simple smart card reader which may be manufactured at low cost. The smart card reader according to the invention enables input through the keypad of the telephone terminal so that the smart card reader does not require a keypad and has no moving parts

10   except a few function keys. Second, it is simple and convenient to connect the smart card reader to a public switched telephone network (PSTN). The smart card reader shares a single telephone line with a telephone terminal that may or may not be an analogue display service

15   interface (ADSI) telephone and requires no modification of the telephone terminal to function therewith. Third, it overcomes the disadvantages of similar prior art smart card readers. There are no sound signals transmitted from the smart card reader to the PSTN through air, no

20   manual typing involved in the transmission of data from the application server so that the smart card reader is able to provide services in a more reliable and more secure manner. The above advantages enable the invention to be widely used by the general public and enables smart

25   card transactions to be performed from home.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood from the detailed description of the embodiments in

30   conjunction with the accompanying drawings in which:

FIG. 1a is a diagram of a smart card transaction system using a voice path through a public

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switched telephone network; in which a smart card reader is connected between a base set and handset of a telephone;

FIG. 1b is a diagram of a smart card
5   transaction system using a voice path through a public switched telephone network; in which a smart card reader is connected between the telephone and the public switched telephone network;

FIG. 2 is a block diagram of a smart card
10   reader used in the system of FIG. 1, showing the functional structure of the smart card reader;

FIG. 3 is a schematic diagram of the smart card reader, showing a watchdog circuit and handset control;

FIG. 4 which appears on sheet one of the
15   drawings is a perspective view of the smart card reader;

FIG. 5 which also appears on sheet one of the drawings is a block diagram of the application server used in the system of FIG. 1, showing the functional structure of the application server.

20

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1a shows a preferred embodiment of the invention. A smart card reader 10 in accordance with the invention uses the voice path of a PSTN 14 for
25   communication with an application server 12. The smart card reader 10 is connected between a handset 18 and a base set 20 or between the base set 20 and the PSTN as will be described below in more detail. The smart card reader 10 may be used with an ADSI telephone or a regular
30   telephone. The application server 12 uses a V.8 bis connection protocol to prompt the smart card reader 10 to mute the handset 18 or the telephone terminal 16 to

permit an exchange of data between the smart card
reader 10 and the application server 12.   If the
telephone terminal is not an ADSI telephone, all
interactions with the user are accomplished using an
5   interactive voice response (IVR) application server.

FIG. 1b shows an alternate arrangement of the
system shown in FIG. 1a in which the smart card reader 10
is connected between the telephone base set 20 and the
PSTN 14.   This arrangement is used with handsfree
10   telephones and the like.   As will be explained below in
more detail, the only modification required to the smart
card reader to support this arrangement is a provision to
provide simulated telephone line current to the base
set 20 when the card reader is in card communication mode
15   and the base set 20 is disconnected from the PSTN 14.

As illustrated in FIG. 2, the smart card
reader 10 includes a smart card reader/writer unit 22,
micro-controller 24, modem circuit 26, a mode selection
circuit 28 and an analogue front-end 30 that respectively
20   support the required functionality of the smart card
reader 10.   An LCD display 32 provides a display surface
for displaying status messages.   Function keys 34 permit
users to select pre-programmed functions.   A power supply
unit 36 connect to a power pack 38 provides operating
25   current to the smart card reader 10.   The connection of
the smart card reader 10 with the handset 18 and base
set 20 is through the analogue front-end 30.   The
functions of those components are described in more
detail below.

30   FIG. 3 illustrates the operational links
between the components shown in FIG. 2.   The front-end 30
includes a switch 40 emulated by some contacts of a

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relay 42. The switch 40 is selectively connected to the handset 18 or to the modem circuit 26 which connects to the micro-controller 24. When the switch 40 is connected to the handset 18, the communication path from the micro-

5   controller 24 through the modem circuit 26 to the application server 12 is disconnected and a user input mode is enabled. In the user input mode, there is no data exchange between the micro-controller 24 and the application server 12 but transaction information can be

10   input through the keypad of the telephone terminal 16. The default position of the switch 40 connects the handset 18 to the telephone 20. Therefore, the switch 40 normally connects the base set 20 and the handset 18 so that the smart card reader 10 does not affect normal

15   telephone operation when the smart card reader 10 is not in use. The switch 40 is actuated by a relay 42 to disconnect the handset 18 when the micro-controller 24 needs to exchange data through modem 26 with the application server 12. The relay 42 is energized by

20   electric power supplied from the power supply unit 36 and controlled by a logic gate 44. The logic gate 44 is controlled by the micro-controller 28 and a watchdog circuit 46, as will be explained below in more detail. Mode selection is driven by a mode selection component 28

25   which includes a V.8 bis tone decoder and generator located between the micro-controller 24 and the analogue front-end 30. However, the V.8 bis tone decoder and generator is directly connected to the base set 20 of the telephone terminals 16 through the analogue front-end 30

30   and input to the circuit is not affected by the switch 40. Before the application server 12 is able to communicate with the smart card reader 10, it has to

switch the smart card reader from a voice mode to a data
mode and initiate a modem start-up procedure (V.25).
This is accomplished using V.8 bis signalling (ITU
COM 14-R, 19-E recommendation V.8 bis) as required by

5   Mondex™ specifications. At that time, the handset 18 is
preferably muted.

The V.8 bis protocol supports signalling and
messaging. Signalling is used to indicate when a V.8 bis
transaction begins. The signals are composed of two

10   parts: segment 1 and segment 2. Segment 1 is a precise
dual-frequency tone that is sent to initiate a V.8
transaction and segment 2 is a single frequency that
represents one of three commands: ES (escape signal),
MR (mode request), CR (capabilities request). Messages

15   are transmitted using V.21 300 bps modulation. Because
the application server 12 is aware that the smart card
reader 10 is V.8 bis compatible, the application
server 12 does not need to send any request messages.
This minimizes the duration of the V.8 bis transaction.

20   The minimum duration of a V.8 bis signal is 500 ms. The
tone decoder detects segment 1 and segment 2 of V.8 bis
signals. Once a valid V.8 bis signal is detected, the
micro-controller 24 requires about 500 ms to activate the
relay 42 that mutes the handset 18 and waits for the

25   incoming V.8 bis message. When the signalling sequence
is finished, the modem circuit 26 is started and
configured in V.21 mode to receive an incoming message.
The micro-controller 24 reads the message and takes
appropriate responsive action.

30   The tone generator of the mode selection
component 28 is used to initiate a V.8 bis signalling

sequence for the purpose of, for example, inter-card reader transactions which will be explained below.

As described above, the logic gate 44 is connected at its output end to the relay 42 and at a first input to the micro-controller 24 and at a second input to a watchdog circuit 46 that resets the micro-controller 24 and reconnects the handset 18 to the base set 20. If the smart card reader 10 fails, the logic gate 44 connects the power circuit to a relay 42, activating the relay 42 and actuating the switch 40 to connect the modem circuit 26 to the telephone for the card communication mode when a V.8 bis tone is detected by the decoder 28 and read by the micro-controller 24. Nevertheless, the logic gate 44 disconnects the relay 42 from the power circuit and releases the switch 40 to its default position to reconnect the handset 14 for normal telephone use when an operation failure is detected by the watchdog 46. It should also be noted that if the smart card reader powers down or if the power fails, the switch 40 is automatically returned to the default position and the handset 18 is connected to the base set 20.

The micro-controller 24 incorporates a core processor (CPU), timers/counters, synchronous and asynchronous serial ports, memories (RAM, EPROM, FLASH), A/D converters and other peripherals. The CPU preferably complies to ISO 7816-3 and 7816-4 requirements and supports T=0 and T=1 protocol types. ISO 7816-3 specifies one bi-directional data line plus one clock for the serial communication interface (12C standard interface). The principal design assumption is that applications run on the application server. However,

there is the exception that the smart card reader may be used to support a inter-card Mondex transactions. For this purpose, the micro-controller 24 should be enabled with software for small applications like reading and

5   writing electronic funds transactions to the smart card. Sufficient memory is needed to support such small applications.

The smart card reader/writer unit 22 is preferably made of plastic and can be mounted directly on

10   a printed circuit board (PCB). In a preferred embodiment, it provides eight pins for smart card contacts and one contact to detect full insertion of the card. A special circuit interfaces with the smart card reader/writer unit 22 to provide the necessary timing for

15   powering, resetting and clocking the smart card. This circuit complies with the ISO 7816-3 and -4, and supports T=0 and T=1 protocol types.

The analogue front-end 30 also includes an automatic gain control (AGC) which ensures that handset

20   volume control does not influence the V.8 bis tone detection circuit and modem operation.

The detection of segment 1 and segment 2 of V.8 bis signals can be done in several ways. In the first option, the incoming V.8 bis signal passes through a

25   clipping circuit to convert sine to square wave forms and the duration is measured by the CPU using internal timers. The second option is to use a detection circuit with filters and phase lock loops (PLLs) able to discriminate V.8 bis from other signals (for example

30   voice) that may occur at the same time. When a V.8 bis signal is detected by the detection circuit, a validating signal is sent to the CPU which measures the duration of

the validating signal. The third option is to use a
commercially available unitary tone decoder integrated
circuit (IC). The forth option is use of a digital
signal processor (DSP). An A/D converter is used to
5 convert the signal and send it to the DSP in digital
format. Then, the DSP processes the incoming data to
validate V.8 bis signals. The DSP may be incorporated in
the micro-controller.

There are also several ways for the tone
10 generator to initiate a V.8 bis sequence. The first
option is to use square waves synthesized by the CPU and
wave shaping (square to sine) is done externally by an
analogue circuit (low). The second option is to use an
analogue sine wave generator, tuned by the CPU with a
15 programmable potentiometer. The third option is use of a
commercially available all-in-one tone generator (IC).

The modem circuit 26 supports V.21, V.22 bis,
V.42 (also V.42 bis) which meets Mondex specifications.
After a V.8 bis transaction is finished, data mode is
20 activated and a V.25 modem start-up is initiated.
Therefore, modems at each end (application server 12 and
the smart card reader 10) are connected and an exchange
of data begins. Because an AGC circuit is included in
the analogue front-end 30, incoming signals are not
25 affected by handset volume control of the telephone
terminal 16. The data is read from and written to the
modem by the CPU through a serial port which is
preferably AT (Hayes) compatible to facilitate modem
management).

30   The smart card reader may be powered by a
battery pack or by power from a power converter of the

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telephone set, if available. At maximum demand the power
requirement is about 1.3W (5V X 255 mA).

The display 32 is required by the Mondex
specifications. Two lines by 16 characters 5 X 7 dots
5   resolution with a back light option is preferred.

Function keys 34 are not mandatory per the
Mondex specifications but are preferably included. The
function keys 34 may be rubber switches with carbon
contacts on the printed circuit board (PCB). The
10 definition, and number of function keys 34, as well as
the pictograms associated with the function keys 34
follow Mondex recommendations. Audible feedback is also
preferred each time a key is pressed to indicate to the
user that the depressed key has been detected. The smart
15 card reader 10 incorporates a buzzer for this purpose.
The display 32 may also be replaced by a voice generator
but this is not the preferred option. Voice generation
requires a lot of CPU memory plus special circuits. The
per unit manufacturing cost is not impacted but the
20 development costs are greater.

FIG. 4 shows a perspective view of the smart
card reader 10. All components of the smart card
reader 10 are mounted in a custom plastic enclosure 48.
A slot 50 for receiving a smart card 52 is at a front-end
25 of the enclosure 48. The slot 50 may also be located in
a top of the enclosure 48 instead of in the front.
Because the smart card reader components are PCB mounted
the orientation of the PCB must be changed if the slot is
relocated. The function keys 34 and display 32 are on
30 the top of the enclosure 48 and all connectors including
power supply input and telephone terminals are at the
rear of the enclosure 48. The connectors 54 used to

connect the telephone base set 20 and handset 18 to the smart card reader 10 are RJ11 handset type connectors. One three-color LED (not shown) is preferably provided to display the following status: green for power on, yellow

5   for communication in progress with the card and red for unit failure.

Smart card firmware includes the following software components:

a main application that includes an application

10   protocol layer for communication with the application server, watchdog relay control and three-color LED control. The watchdog circuit is kept active by a signal sent at least every second;

flash memory management for writing and reading

15   control;

a smart card reader driver that includes a card reader through a synchronous serial port (one data line, one clock);

a modem driver;

20   a display/function keys driver that includes LCD/function key drivers as per the Mondex specification;

a transport/network protocol layer as defined in the Mondex specification; and

a Mondex electronic purse application that is

25   explained in the Mondex specification.

Server-based card reader applications need not be interpreted and are passed through from the server to the card. For inter-smart card applications, Mondex software is preferably implemented.

30   The main components of the application server 12 are illustrated in FIG. 5. The application server 12 includes application software 56 that provides

smart card services. Other services such as an electronic telephone book may also be supported. The application software 56 is preferably configured to communicate and control two devices, an ADSI telephone

5 and the smart card reader. If a regular telephone is used with the smart card reader 10, the ADSI component is not required. A telephony card 58 is used to communicate with the telephone terminal 16 for voice and ADSI protocol and a modem card provides a second interface

10 used to communicate with the smart card reader 10. The telephony card 58 preferably includes up to 23 B channels, an interface for playing voice prompts, an interface for communications using ADSI protocol, a primary rate interface (PRI) communication link interface

15 and a data bus that permits routing of B channels between the telephony card 58 and the modem card 60. The modem card 60 provides an interface for 24 modems supporting up to 56 KBPS and the data bus permits routing of B channels between the telephony card 58 and the modem card 60.

20   When a user dials the server, the service access number (DNIS) dialled by the user is used to determine which application process is started for the duration of the call. The application software 56 is responsible for all the interactions with the user and

25 control of the smart card reader 10. The user interaction is directed using visual displays on the ADSI telephone combined with voice prompts. Only voice prompts are used when the smart card modem is connected to a regular telephone.

30   At the beginning of a session in which an ADSI telephone is used, the application software 56 uses ADSI protocol and voice prompts to guide the user through

menus. During this time, the ADSI telephone terminal 16 is in data communication mode and is switched temporarily to voice mode to permit voice prompts to be played. The ADSI application software 56 is designed so that a CAS tone used to switch to data mode is normally heard only at the beginning of a session. This means that the temporary switch to voice does not require a CAS tone to return to data mode. The telephone terminal 16 may be instructed to switch to voice mode for a few seconds (time required to play a voice prompt for example) and return to data mode automatically. While the telephone terminal 16 is in data mode, the handset 18 is muted. With the smart card reader 10 connected to the handset 18, it is necessary to switch to voice mode to communicate with the smart card reader 10. There are two options for doing this. First, the temporary switch to voice may be used. In this case, the duration of the data transfer between the smart card 52 and the application server 12 has to be known and to be less than 127 seconds. The advantage of this option is no new CAS tone is needed to switch back to data mode. However, one has to be certain that data transfer will be terminated before the telephone switches back to data mode. The second option is to switch permanently to voice mode, do the data transfer and then reinitiate ADSI data mode by re-sending the CAS tone. This method is required for data transfers of unknown size. The best implementation is to use both options according to the type of data being exchanged. Of course, with a regular telephone, the application server does not need to switch to voice mode because the telephone is always in voice mode.

While in voice mode, communication with the smart card 10 can begin. The application software 56 must route the B channel used (0-23) to an available modem of the modem card. The B channel is routed by the

5   data bus on two time slots (full duplex). The application software 56 can determine the time slot numbers using the telephony card. One of the modems is connected to these time slots. Then, the communication can begin.

10   The V.8 bis connection protocol is initiated by the modem card. The smart card reader tone decoder and the modem circuit 26 detect the tone and the connection process begins. As soon as a valid connection process begins, the smart card reader can mute the handset 18.

15   When the modems are synchronized, the application service layer protocol as defined in the Mondex specification is used between the application server 12 and the smart card reader to exchange information. The smart card reader 10 disconnects when

20   the communication is completed, if the modem remote carrier is lost or the smart card 52 is removed from the reader slot 50, the application software 56 switches back into ADSI data mode to continue with the user interaction. In a normal situation, an End Data Transfer

25   message is sent as defined in transport layer protocol of the Mondex protocol.

In order to illustrate a typical application and system behaviour, a sequence of events for a re-loadable telecom electronic purse as described as an

30   example of a subset of multi-function telecom card applications.

1.   A user inserts the smart card into the smart card reader 10.   If the card is properly inserted, the smart card reader status LED blinks green, if not well inserted, the smart card reader status LED blinks

5   red.

2.   The user selects the telecom card service from the services key of the ADSI telephone or dials the application server number.   After the number is dialled, the application server answers the call and according to

10   the telephone number dialled, it starts a telecom card (TC) application.   A TC application tests the ADSI compatibility of the user telephone set.

3.   In the event that the user is requested to enter a personal identification number (PIN) and the

15   communication is with an ADSI telephone, the system behaves as follows:

a)   a message is displayed asking for the PIN with a voice prompt;

b)   the user enters the PIN and presses OK,

20   "*" characters are displayed on display while the PIN is entered;

c)   the   server   application   switches   the telephone from data to voice mode;

d)   the   server   application   establishes   the

25   communications with the smart card reader;

e)   the PIN is read from the smart card as well as other data that is required for later processing, for example, a credit card number, the amount of money on the card, etc.;

30   f)   the PIN is validated;

g)   if the PIN is invalid, steps a, b and f
are repeated, and after three invalid attempts, the
communication is terminated.

If the communication is not with an ADSI
telephone:

a)   a voice prompt requesting the PIN is
played;

b)   the user enters the PIN using the
telephone keypad and presses the # key;

c)   the server applications establishes the
communications with the smart card reader;

d)   the PIN is read from the smart card as
well as other data as explained above;

e)   the PIN is validated; and

f)   if the PIN is invalid, steps a, b and e
are repeated, and after three invalid attempts, the
communication is terminated.

4.   In order to select the electronic purse
application, if an ADSI telephone:

a)   the server application switches the
telephone from voice to ADSI data mode;

b)   a message is displayed asking for
selection with a voice prompt; and

c)   the user selects electronic purse and
presses OK.

If not an ADSI telephone:

a)   a voice prompt asking for service option
selection is played, for example, press 1 for electronic
purse, press 2 for ....; and

b)   the user selects electronic purse option
by pressing the appropriate key on the telephone keypad.

5.   The user may then key in his credit card number or validate the one already written on the card.

If an ADSI telephone is connected:

a)   a message is displayed asking for confirmation of a credit card number or entry of a credit card number with a voice prompt; and

b)   the user enters his credit card number and presses OK.

If not an ADSI telephone:

a)   a voice prompt asks for confirmation of the credit card number or entry of a credit card number; and

b)   the user enters the card number and presses "#".

6.   The user keys in the amount to transfer to the card (restrictions may apply to the amount to transfer to the card).

If an ADSI telephone:

a)   a message is displayed asking for the amount to transfer with a voice prompt (present amount on the card is to be displayed);

b)   the user enters the amounts and presses OK;

c)   fund availability is validated on-line;

d)   if available, the server application switches the telephone from data to voice mode and establishes the communications with the smart card reader;

e)   the amount is transferred to the card; and

f)   confirmation of the new electronic value is displayed on the screen.

If not an ADSI telephone:

a)   a   voice   prompt   asks   for   the   amount
(present amount on card is also announced);

b)   the   user   enters   the   amount   and   presses
"#";

5   c)   fund availability is validated on-line;

d)   if   funds   are   available,   the   server
application switches the telephone from data to voice
mode and establishes the communication with the smart
card reader;

10   e)   the amount is transferred to the card; and

f)   confirmation of the new electronic value
is announced.

As explained above with reference to FIG. 1b,
another embodiment of the invention, the smart card
15   reader 10 may be connected directly to the telephone line
between the PSTN and the telephone base set 20 with no
major structural change.   Only the analogue front-end is
impacted.   In this embodiment, a switch in the front-end
keeps the telephone terminal connected to a -48 V. power
20   source to have the telephone terminal works properly
while the smart card reader is in card communication mode
and the telephone base set is disconnected from the PSTN
14.   This embodiment is useful for implementation with
handsfree telephones and the like.

CLAIMS:

1.   A portable smart card reader (10) adapted for
communication with an application server (12) using a
voice path of a switched telephone network (14), the
smart card reader including a smart card reader/writer
unit (22) for reading information from and writing
information to a smart card (52) inserted in a slot (50)
for receiving the smart card, a micro-controller (24) for
operational control of the smart card reader/writer unit
and a display unit (32), C H A R A C T E R I Z E D by:
          a front-end (30) for selectively connecting the
smart card reader/writer unit (22) to a telephone line
that is shared with a telephone terminal (16) to permit
communication with the application server, and to
selectively disconnect the smart card reader/writer unit
(22) from the telephone line to permit a keypad of the
telephone terminal to function as a user interface for
input of information during a smart card transaction
session.

2.   A smart card reader (10) as claimed in claim 1
wherein the front-end (30) is adapted to be connected in
series between a base set (20) and a handset (18) of the
telephone terminal (16).

3.   A smart card reader (10) as claimed in claim 2
wherein the micro-controller (24) selects one of a card
communication mode and a user input mode during a card
transaction session, and mutes the handset (18) in the
card communication mode.

4.   A smart card reader (10) as claimed in claim in any preceding claim further comprising a modem circuit (26) linked between the micro-controller (24) and the front-end (30) for transmitting an electronic signal.

5.   A smart card reader (10) as claimed in claim 4 wherein the front-end (30) comprises a switch (40) controlled by the micro-controller (24) for alternate connection of the base set (20) with the handset (18) or with the modem circuit (26) to complete the mode selection.

6.   A smart card reader (10) as claimed in claim 5 further comprising a monitoring unit (46) associated with the micro-controller (24) and the switch (40) for resetting the micro-controller and disconnecting the smart card reader from the handset if the smart card reader fails.

7.   A smart card reader (10) as claimed in any preceding claim further comprising a connection signal detector associated (28) with the micro-controller (24) and the front-end (30) for detecting a connection signal sent from the application server (12) to activate the card communication mode.

8.   A smart card reader (10) as claimed in any preceding claim further comprising a connection signal generator (28) associated with the micro-controller (24) and the front-end (30) for sending a connection signal to the application server (12).

9.   A smart card reader (10) as claimed in claim 6
wherein the switch (40) connects the base set (20) with
the handset (18) in a normally closed condition to ensure
that the user input mode is a default mode.

10.   A smart card reader (10) as claimed in any
preceding claim further comprising a plurality of
function keys (34) that serve as a user interface for
function selection.

11.   A smart card reader (10) as claimed in any
preceding claim wherein the micro-controller (24)
comprises a memory and software to support inter-smart
card applications.

12.   A smart card reader (10) as claimed in any
preceding claim wherein the display unit (32) comprises a
liquid crystal display (LCD) for brief status message
display.

13.   A smart card transaction system that uses a
voice path through a switched telephone network (14) to
perform smart card transactions, the transaction system
including an application server (12) connected to the
switched telephone network; a telephone terminal (16)
connected to the switched telephone network, the
telephone terminal having a keypad; and, a portable smart
card reader (10) for communication with the application
server (12),the smart card reader including: a smart card
reader/writer unit (22) for reading information from and
writing information to a smart card (52); a micro-

controller (24) associated with the smart card
reader/writer unit for controlling same; a display unit
(32) associated with the micro-controller for displaying
information; and, a slot (50) for receiving a smart card
(52), C H A R A C T E R I Z E D by:

the smart card reader further including a
front-end (30) linked to the smart card reader/writer
unit (22) for selectively connecting the smart card
reader/writer unit to a telephone line that is shared by
a telephone terminal (16), to enable communication with
the application server (12) and selectively disconnecting
the smart card reader/writer unit (22) from the telephone
line to permit a keypad of the telephone terminal to be
used as a user interface for input of information during
a smart card transaction session.

14.   A smart card transaction system as claimed
in claim 13 wherein the telephone terminal (16) comprises
a base set (20) with the keypad and a handset (18), the
front-end (30) of the card reader being connected in
series between the base set and the handset.

15.   A smart card transaction system as claimed in
any one of claims 13 or 14 wherein the micro-controller
(24) controls a mode selection between a card
communication mode and a user input mode during the card
transaction session, and mutes the handset (18) in the
card communication mode.

16.   A smart card transaction system as claimed in
any one of claims 13-15 wherein the smart card reader
(10) comprises a modem circuit (26) linked between the

micro-controller (24) and the front-end (30) for transmitting the electronic signal.

17.   A smart card transaction system as claimed in claims 16 wherein the front-end (30) comprises a switch (40) controlled by the micro-controller (24) for alternate connection of the base set (20) with the handset (18) or with the modem circuit (26) to complete the mode selection.

18.   A smart card transaction system as claimed in claim 17 wherein the smart card reader (10) comprises a monitoring unit associated with the micro-controller (24) and the switch (40) for resetting the micro-controller and disconnecting from the handset (18) if the card reader fails.

19.   A smart card transaction system as claimed in any one of claims 13-18 wherein the smart card reader (10) comprises a connection signal detector (28) associated with the micro-controller (24) and the front-end (30) for detecting a connection signal sent from the application server (12) to activate the card communication mode.

20.   A smart card transaction system as claimed in claim 19 wherein the smart card reader (10) comprises a connection signal generator (28) associated with the micro-controller (24) and the front-end (30) for sending out a connection signal.

21.   A smart card transaction system as claimed in any one of claims 17-20 wherein the switch connects the base set (20) with the handset (18) in a normally closed condition to ensure the telephone is in a user mode when the smart card reader (10) is not in use.

22.   A smart card transaction system as claimed in any one of claims 13-21 wherein the smart card reader (10) comprises a plurality of function keys (34) that function as a user interface for function interaction.

23.   A smart card transaction system as claimed in any one claims 13-22 wherein the micro-controller (24) comprises a memory and software to support inter-smart card applications without communication with the application server.

24.   A smart card transaction system as claimed in any one of claims 13-23 wherein the display unit (32) comprises liquid crystal display (LCD) for displaying brief status messages.

25.   A smart card transaction system as claimed in any one of claims 13-24 wherein the application server (12) comprises:

        application software for providing services;

        a first interface associated with the application software to communicate with and control the telephone terminal (16); and

        a second interface associated with the application software to communicate with and control the smart card reader (10).

26.   A smart card transaction system as claimed in
claim 25 wherein the second interface generates a
connection signal to prompt the smart card reader (10) to
switch to the card communications mode.

27.   A smart card transaction system as claimed in
claim 25 wherein the first interface provides the
functions of:

        playing voice prompts;

        communications using analogue display service
interface (ADSI) signals; and

        a primary rate interface (PRI) communication
link.

28.   A smart card transaction system as claimed in
any one of claims 25-28 wherein the application server
(12) comprises an interactive voice response (IVR) unit
for voice prompts.

29.   A method of using a voice path trough a
switched telephone network (14) for a smart card
transaction comprising the steps of: receiving a call
from a telephone terminal (16) connected to a telephone
line of the switched telephone network (14) at an
application server (12) which is connected to the
switched telephone network; verifying from the
application server (12) that a smart card reader (10) is
connected to the telephone line of the switched telephone
network and a smart card is properly associated
therewith; verifying at the application server the smart
card user ID information by retrieving smart card user ID

information from the smart card in a card communication mode and comparing the retrieved information with input user ID information; and exchanging transaction data between the smart card and the application server in the card communication mode, C H A R A C T E R I Z E D by the steps of:

a) inputing the smart card user ID information using a keypad of the telephone terminal (16) in a user input mode;

b) inputing application server transaction information using the keypad of the telephone terminal in the user input mode; and

c) prompting the smart card reader (10) from the application server to switch selectively between the user input mode that permits input through the keypad of the telephone terminal (16) and the card communication mode that permits information exchange between the smart card and the application server.

30.   A method as claimed in claim 29 wherein the user input mode is a default mode.

31.   A method as claimed in claim 29 wherein the card communication mode mutes a handset (18) of the telephone terminal (16).

32.   A method as claimed in any one of claims 29-31 wherein the application server (12) sends a connection signal to activate the switching from the user input mode to the card communication mode.

33.   A method as claimed in any one of claims 29-32 wherein after the communication of the telephone terminal (16) with the application server (12) is established, a transaction messages are sent from the application server (12) to the telephone terminal (16) to guide users through the card transaction session.

34.   A method as claimed in claim 29 further comprising a step of:

       d) executing an action at the application server (12) on receipt of an input signal from a function key associated with the smart card reader (10) when the smart card reader (10) is in the card communication mode and the function key is pressed.

35.   A method as claimed in any one of claims 29-34 wherein the smart card reader (10) is connected in series between the handset (18) and a base set (20) of the telephone terminal (16).

36.   A method as claimed in any one of claims 29-35 wherein the application server (12) communicates with and controls the telephone terminal (16) through a first interface, and communicates with and controls the smart card reader (10) through a second interface, the first and second interfaces being associated with software programs for enabling transaction services.

37.   A method as claimed in claim 36 wherein the software programs guide users through transaction menus using analog display service interface (ADSI) signals and

voice prompts via the first interface when the telephone terminal (16) is an ADSI telephone.

38.   A method as claimed in claim 37 wherein the application server (12) switches the ADSI telephone to a voice mode when the application server communicates with the smart card reader (10).

39.   A method as claimed in claim 36 wherein the software programs guide users through transaction menus using an interactive voice response (IVR) unit for voice prompts via the first interface when the telephone terminal (16) is not an ADSI telephone.

FIG. 1a

FIG. 1b

FIG. 4

FIG. 5

FIG. 2

FIG. 3
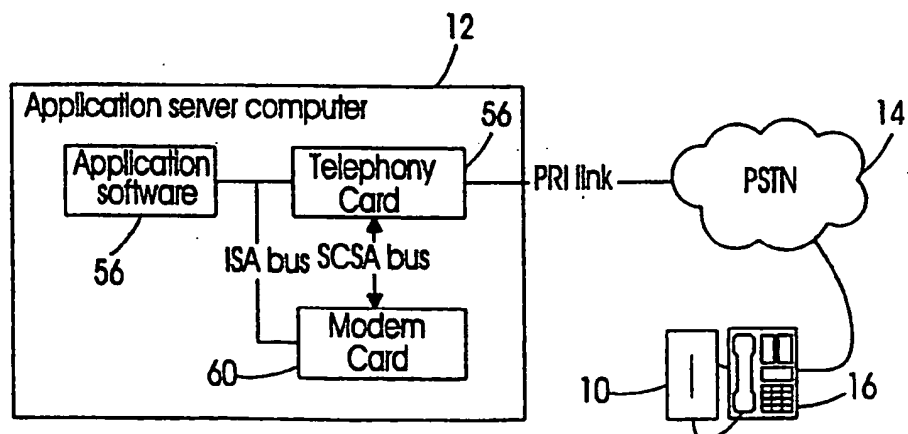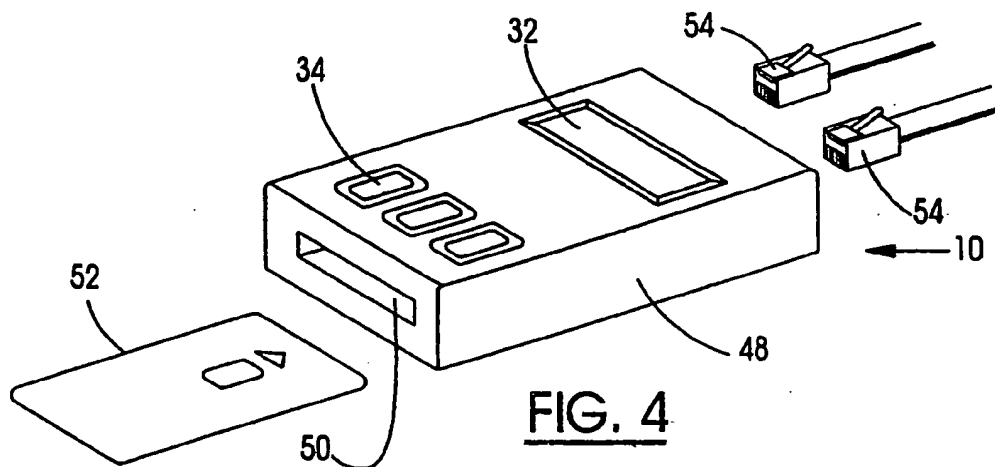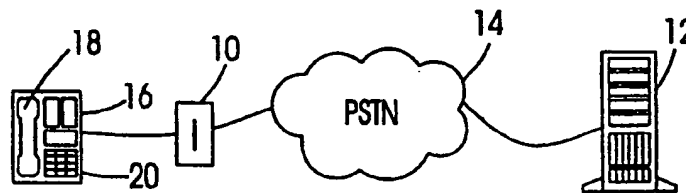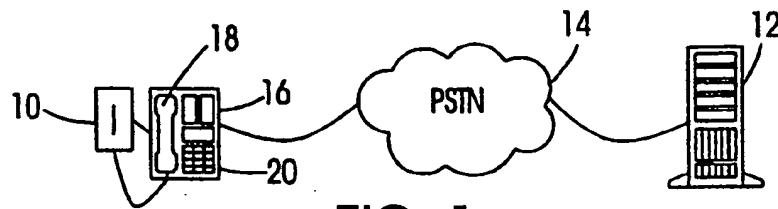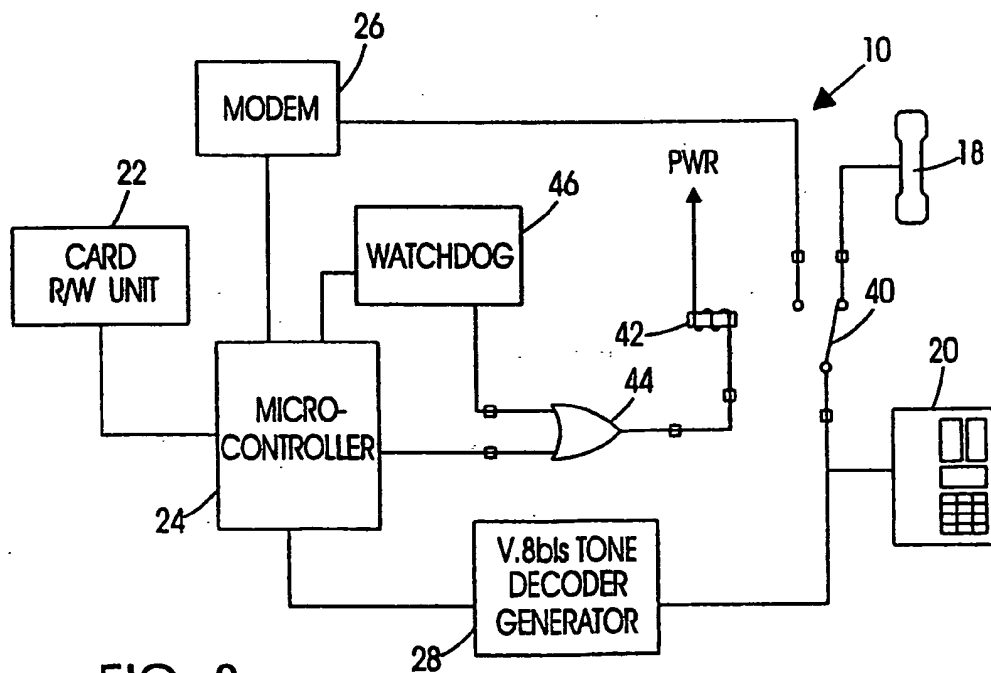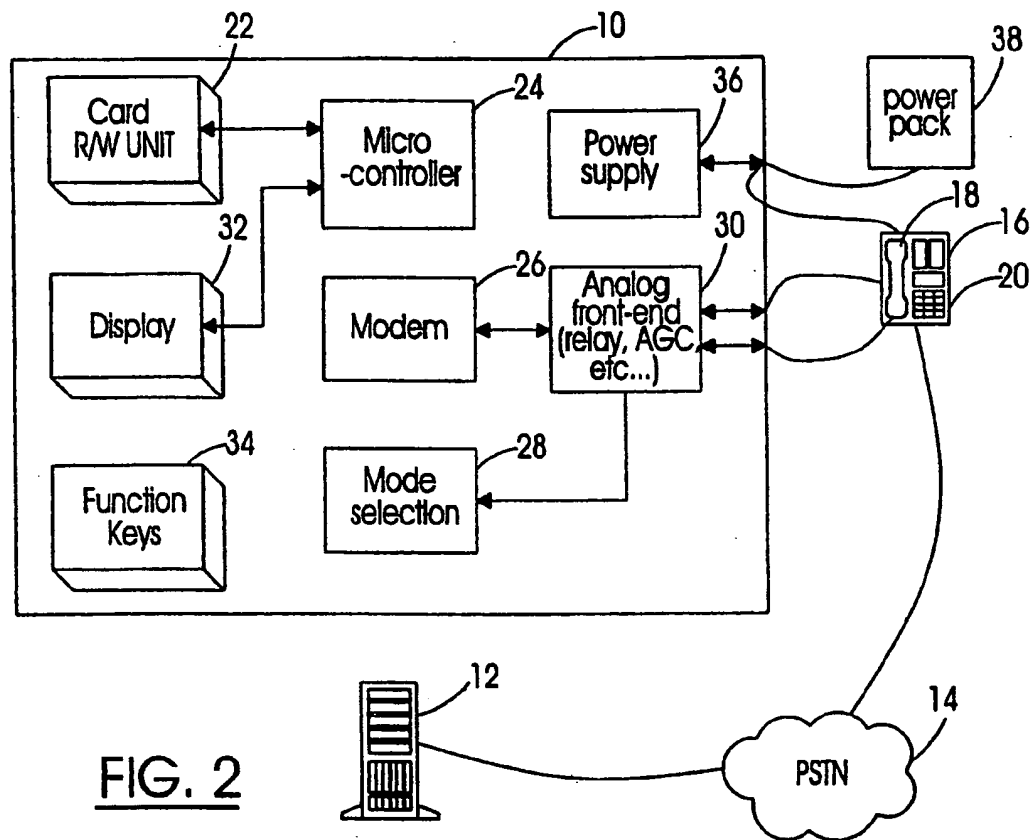
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   G07F7/10   G07F7/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   G07F   H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category°	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 793 206 A (HITACHI LTD) 3 September 1997 (1997-09-03) column 2, line 26 - line 35 column 8, line 4 - line 47 column 11, line 52 -column 12, line 2 column 14, line 28 -column 15, line 14 figure 15	1-39
A	US 5 748 737 A (DAGGAR ROBERT N) 5 May 1998 (1998-05-05) column 10, line 13 - line 44 column 18, line 30 - line 33	1-39

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 January 2000	03/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Vaucois, X

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